AMENDMENTS TO THE SPECIFICATION:

Page 1, please add the following new paragraphs before paragraph [0001]:

[0000.2] CROSS-REFERENCE TO RELATED APPLICATIONS

[0000.4] This application is a 35 USC 371 application of PCT/DE 03/02175 filed on June 30, 2003.

[0000.6] BACKGROUND OF THE INVENTION

Please add the following new paragraph after paragraph [0001]:

[0001.2] This invention relates to an improved fuel injection system for internal combustion engines, including a pressure booster and a reduced quantity low pressure circuit.

Please add the following new paragraph after paragraph [0001.2]:

[0001.4] Description of the Prior Art

Please replace paragraph [0002] with the following amended paragraph:

[0002] ~~For supplying combustion chambers of self-igniting internal combustion engines with fuel, both~~ Both pressure-controlled and stroke-controlled injection systems ~~can be employed~~ are known for supplying combustion chambers of self-igniting internal combustion engines with fuel. As fuel injection systems, not only unit fuel injectors and pump-line-nozzle units but also reservoir injection systems are also used. Reservoir injection systems (common rails) advantageously make it possible to adapt the injection pressure to the load and rpm of the engine. To attain high specific outputs, a high injection pressure is required. The higher the attainable injection pressure, the less are the emissions from the engine.

Please replace paragraph [0004] with the following amended paragraph:

[0004] German Patent Disclosure DE 199 10 970 A1 ~~has~~ discloses a fuel injection system ~~as its subject. This system has~~ having a pressure boosting unit, which is located between a pressure reservoir and a nozzle chamber and whose pressure chamber communicates with the

nozzle chamber via a pressure line. A bypass line connected to the pressure reservoir is also provided. The bypass line communicates directly with the pressure line. The bypass line can be used for a pressurized injection and is located parallel to the pressure chamber, so that the bypass line is passable, regardless of the motion and position of a displaceable pressure fluid in the pressure boosting unit. This makes greater flexibility in terms of the injection possible.

Please replace paragraph [0005] with the following amended paragraph:

[0005] German Patent Disclosure DE 101 23 911.4 relates to a fuel injection system with a pressure boosting device. A fuel injection system for internal combustion engines includes a fuel injector, which can be supplied from a high-pressure fuel source and has a pressure boosting device. The pressure boosting device includes a movable piston, which divides a chamber connected to the high-pressure fuel source from a high-pressure chamber communicating with the injector. The high-pressure chamber communicates with a differential pressure chamber via a fuel line, so that the high-pressure chamber can be filled with fuel via the differential pressure chamber of the pressure boosting device. The triggering of the fuel injection system with the pressure boosting device known from DE 101 23 911.4 is effected via a pressure relief of the differential pressure chamber of the pressure boosting device. ~~**In the embodiments**~~ The systems known from DE 199 10 970 A1 and DE 101 23 911.4, ~~**the fuel injection system includes**~~ include a stroke-controlled fuel injector. Each fuel injector is assigned a pressure booster, for elevating the injection pressure as needed. The triggering of the pressure boosting device is effected via a simple 2/2-way valve and leads to reduced depressurization losses, since the differential pressure chamber of the pressure boosting device is pressure-relieved for its actuation. Moreover, these ~~**embodiments**~~ systems make it possible to perform multiple injections and to shape the injection course flexibly.

Page 3, please replace paragraph [0007] with the following amended paragraph:

[0007] ~~**Summary of the Invention**~~ SUMMARY OF THE INVENTION

Page 4, please replace paragraph [0010] with the following amended paragraph:

[0010] ~~**Drawing**~~ BRIEF DESCRIPTION OF THE DRAWINGS

Please replace paragraph [0011] with the following amended paragraph:

[0011] The invention will be described in further detail below in conjunction with the ~~**drawing.**~~ drawings, in which:

Please delete paragraph [0012].

Please replace paragraph [0013] with the following amended paragraph:

[0013] Fig. 1[[,]] is the hydraulic layout of the high-pressure and low-pressure circuits in a high-pressure common rail injection system with a pressure booster;

Please replace paragraph [0014] with the following amended paragraph:

[0014] Fig. 2[[,]] is a schematic illustration of the hydraulic mode of operation of a fuel injection system with a common rail and a pressure booster; and

Please replace paragraph [0015] with the following amended paragraph:

[0015] Fig. 3[[,]] is a schematic illustration of the hydraulic interconnection~~**, proposed**~~ according to the invention of the low-pressure circuit of a fuel injection system with a pressure booster and a common rail.

Please replace paragraph [0016] with the following amended paragraph:

[0016] ~~**Variant Embodiments**~~ DESCRIPTION OF THE PREFERRED EMBODIMENTS

Please delete paragraph [0017].

Page 5, please replace paragraph [0018] with the following amended paragraph:

[0018] Fig. 1 shows the hydraulic interconnection of the components of a fuel injection system with a common rail and a pressure booster, along with the components used in it. The fuel injection system with a high-pressure reservoir or common rail 4 and a pressure booster 7 upstream of a fuel injector 10 includes a high-pressure pumping unit 1. A metering unit, not shown in further detail, precedes the high-pressure pumping unit 1, and by way of it fuel is metered as needed to the high-pressure pumping unit. From a fuel tank 14, which contains fuel whose fuel level is shown at 15, fuel flows via an inlet 16 to a prefeed pump upstream of the high-pressure pumping unit 1. The fuel is compressed in that pump to the prefeed pressure. Next, the compressed fuel travels through a fuel filter 17 and is metered, controlled by demand, by a metering unit not shown in further detail to the high-pressure pumping unit 1. Control, scavenging and lubrication quantities are returned to the fuel tank 14 via a return line 19.

Please replace paragraph [0019] with the following amended paragraph:

[0019] The fuel compressed to the prefeed pressure is further compressed in the high-pressure pumping unit 1 and stored in the common rail 4. The high-pressure pumping unit 1 communicates with the common rail 4 via a high-pressure supply ~~line 2. The high-pressure~~ line 2 which is accommodated at a high-pressure connection 3 on the common rail 4.

Page 6, please delete paragraph [0024].

Please replace paragraph [0025] with the following amended paragraph:

[0025] From Fig. 2, the hydraulic mode of operation of a fuel injection system which includes a pressure booster can be seen. Via the supply line 6, fuel, which is at the pressure level prevailing in the common rail 4 (not shown here) is delivered to the pressure booster 7.

The fuel flows into a work chamber 26 of the pressure booster 7 via the supply line 6. Both a first conduit 23 and a second conduit 24 extend parallel to the supply line that acts on the work chamber 26 of the pressure booster 7. A filling valve 20 is accommodated inside the first conduit 23; the second conduit 24 includes a throttle restriction 21. Both the first conduit 23 and the second conduit 24 and an overflow line 25 that contains a check valve 22 all communicate with a differential pressure chamber 27 of the pressure booster 7. A restoring spring 30 is accommodated inside the differential pressure chamber 27 and acts upon the lower face end of a booster piston 28 that divides the work chamber 26 from the high-pressure chamber 9. On the booster piston 28, there is a face end 29, which upon pressure relief of the differential pressure chamber 27 of the pressure booster 7 moves into the high-pressure chamber 9. The face end 29 that moves into the high-pressure chamber 9 upon pressure relief 27 of the pressure booster 7 brings about a still-further pressure increase of the fuel contained in the high-pressure chamber 9, in accordance with the boosting ratio of the pressure booster 7 inside the high-pressure chamber 9. A pressure relief of the differential pressure chamber 27 of the pressure booster 7 is effected by a triggering of an actuating valve identified by reference numeral 31. The actuating valve 31 for pressure relief of the differential pressure chamber 27 may for instance be embodied as a 2/2-way valve and communicates with a low-pressure region, not shown in further detail here in Fig. 2.

Page 7, please replace paragraph [0027] with the following amended paragraph:

[0027] The high-pressure supply line 33 extending from the high-pressure chamber 9 of the pressure booster 7 to the fuel injector 10 discharges into a nozzle chamber 38 embodied in the injector body 11 of the fuel injector 10. Moreover, via the high-pressure supply line 33, a control chamber 34 of the fuel injector 10 is acted upon via an inlet throttle 35. A pressure

relief of the control chamber 34 for actuating an injection valve member 37, preferably embodied as a nozzle needle, is effected by the triggering of an actuating valve 32, which may be embodied as a 2/2-way valve. A pressure relief of the control chamber 34 is effected via an outlet throttle 36 into the return 13, which adjoins the actuating valve 32 for triggering the fuel injector 10.

Page 8, please replace paragraph [0030] with the following amended paragraph:

[0030] Upon pressure relief of the differential pressure chamber 27 via the actuating valve 31, the booster piston 28 moves with its face end 29 into the high-pressure chamber 9. An elevated fuel pressure is reached in this chamber, in accordance with the boosting ratio of the pressure booster 7. ~~In~~ From the high-pressure chamber 9, the fuel flows to the nozzle chamber 38 via the high-pressure supply line 33 and acts on the pressure shoulder 42 embodied on the injection valve 37. The control chamber 34 is pressure-relieved via the outlet throttle 36 upon switching of the actuating valve 32. ~~**The injection valve member 37 moves upward counter to the action of the nozzle spring 40, causing an injection of fuel into the combustion chamber 44.**~~ Upon switching of the actuating valve 32, the control chamber 34 is relieved, and injection valve member 37 moves upward counter to the action of the nozzle spring 40 causing an injection of fuel into the combustion chamber 44. For the hydraulic function of the pressure boosting, it does not matter whether the fuel in the differential pressure chamber 27 of the pressure booster is depressurized completely or has a residual pressure that is approximately equivalent to the prefeed pressure. The preservation of a slight residual pressure level inside the differential pressure chamber 27 of the pressure booster is more likely advantageous, for preventing cavitation effects in the differential pressure chamber 27.

Please replace paragraph [0031] with the following amended paragraph:

[0031] By actuation of the switching valve 31 to its closing position, that is, the interruption of the low-pressure-side communication with the return, filling of the differential pressure chamber 27 of the pressure booster 7 takes place, via the first conduit 23 and the second conduit 24. After that, the booster piston 27, reinforced by the restoring spring 30 accommodated in the differential pressure chamber 27, returns to its position of repose, so that the high-pressure chamber 9 of the pressure booster 7 is pressure-relieved. As a consequence, the pressure in the nozzle chamber 38 drops. The closing motion of the injection valve member 37, embodied as a nozzle needle, is initiated by switching ~~a~~ the switching valve 32, which pressure-relieves the control chamber 34, into its closing position, so that a pressure buildup is effected in the control chamber 34, by way of the inlet throttle 35 that branches off from the high-pressure supply line 33.

Page 9, please delete paragraph [0032].

Please replace paragraph [0033] with the following amended paragraph:

[0033] Fig. 3 shows the circuitry proposed according to the invention for a low-pressure region of a fuel injection system with a pressure booster and a common rail. In ~~the~~ this fuel injection system ~~shown in Fig. 3,~~ the high-pressure pumping unit 1, via the high-pressure line 2, pumps fuel into the common rail 4. Six supply line connections are shown for the common rail 4, and by way of them a 6-cylinder self-igniting internal combustion engine is supplied with fuel. Instead of the six high-pressure line connections shown in Fig. 3, either four, five, eight, ten or twelve high-pressure line connections may be provided on the common rail, in accordance with the number of cylinders of the engine to be supplied with fuel. Via the supply line 6 from the common rail 4, the work chamber 26 of the pressure booster 7 is

subjected to pressure. The pressure booster 7 includes a booster piston 28, which divides the work chamber 26 from the differential pressure chamber 27. ~~As shown in Fig. 2, a~~ A restoring spring, which returns the booster piston 28 to its position of repose, may be accommodated in the differential pressure chamber 27 of the pressure booster 7. A subjection of the differential pressure chamber 27 of the pressure booster 7 to fuel is effected via the supply line 6, which discharges into the second conduit 24 that includes the throttle restriction 21. The pressure relief of the differential pressure chamber 27 is effected via the return line 8, which by means of the switching valve 31 with a return line 50, assigned to the pressure booster ~~to the differential pressure chamber 27, or disconnected from it~~.

Page 10, please replace paragraph [0036] with the following amended paragraph:

[0036] With the switching valve 32 open, the injector control quantity flows out of the control chamber 34 via the outlet throttle 36. Via the return line 13, the injector control quantity flows away into the pressureless fuel tank 14. Arrows 53 indicate further return lines 13 of the further fuel injectors 10 for supplying fuel to the self-igniting engine. These lines likewise discharge ~~into~~ through the return 13 into the pressureless fuel tank 14. The return 50 associated with the pressure booster 7, however, discharges into a compensation container 51 inside a low-pressure circuit 64 of the fuel injection system shown in Fig. 3. Arrows 52 indicate further pressure booster returns 50, associated with further pressure boosters 7, which also flow back into the compensation container 51. For the hydraulic function of the pressure booster 7, it does not matter whether the fuel in the differential pressure chamber 27 of the pressure booster 7 is depressurized completely or to a residual pressure approximately equivalent to the pressure built up by a prefeed pump 55. A slight residual pressure in the

differential pressure chamber 27 of the pressure booster 7 is more likely to be advantageous, for avoiding cavitation effects.

Page 12, please replace paragraph [0039] with the following amended paragraph:

[0039] For ~~security~~ safety purposes, an overpressure valve 54 is provided downstream of the compensation container 51, in the direction of outflow of the fuel contained in the compensation container. This overpressure valve 54, analogously to the returns 13 extending from the fuel injectors 10, communicate with the pressureless fuel tank 14. The return quantity originating in the six pressure boosters 7 of a six-cylinder self-igniting engine may be fed into the line segment 60 at a first infeed point 61. If the fuel quantities diverted from the pressure boosters 7 upon pressure relief of the ~~work~~ differential pressure chambers 27 are fed in upstream of the fuel filter 17, then advantageously, cleaning of the diverted return quantities from the pressure boosters 7, 52 can be achieved. Alternatively, it is possible for the return quantities from the pressure boosters 7, accommodated in the compensation container 51, to be fed in at a second infeed point 62, which is downstream of the fuel filter 17. Feeding the return quantities from the pressure boosters 7 in at the second infeed point 62 via a second infeed portion 66.2 offers the advantage that the size of the fuel filter 17 can be reduced, which is favorable in terms of the structural volume.

Please replace paragraph [0040] with the following amended paragraph:

[0040] The return quantities flowing back into the compensation container 51 from the pressure boosters 7 can finally also be delivered at a third infeed point 63 via a third infeed portion 66.3 into the introduction portion 60 in the low-pressure circuit 64. The third infeed point 63 is downstream of a metering unit 59, which takes on the metering of fuel to the high-pressure pumping unit 1 outside the low-pressure circuit 64 in a demand-controlled fashion.

By means of a third infeed point 63 downstream of the metering unit 59, it can be attained that the return quantities from the pressure boosters 7 are introduced into the introduction portion 60 downstream of the metering unit 59, which is upstream of the high-pressure pumping unit 1 outside the low-pressure circuit 64, so that the requisite flow cross section of the metering unit 59 can be kept small. By feeding the return quantity, contained in the compensation container 51, from the pressure boosters 7 in the introduction portion 60, the volumetric flow of fuel to be pumped by the prefeed pump 55 can be reduced considerably in all three feeding variants, that is, positions 61, 62 and 63. This makes a smaller size of the prefeed pump 55 possible, since the feed ~~**pump line**~~ output to be produced by the prefeed pump 55, in terms of the volumetric flow of fuel that is delivered to the high-pressure pumping unit 1 outside the low-pressure circuit 64, ~~**in order for**~~ is supplemented by the return quantities, diverted from the pressure boosters 7 and delivered from the compensation container 51 inside the introduction portion 60 to the infeed points 61, 62, 63 ~~**to be supplemented**~~. The pressure level prevailing in the low-pressure circuit 64, which level is built up by the prefeed pump 55, is preferably in the range between 5 and 7 bar, which corresponds to the residual pressure level that remains in the ~~**work**~~ differential pressure chamber 27 upon relief of the differential pressure chamber 27 of the pressure booster 7 upon triggering of its actuating valve 31. Pressure fluctuations inside the introduction portion ~~**30**~~ 60 can be compensated for by a pressure regulating valve 57, which is accommodated in a line segment that discharges into the fuel tank 14 and that branches off inside the introduction portion 60, between the fuel filter 17 and the metering unit 59.

Page 13, please replace paragraph [0041] with the following amended paragraph:

[0041] By means of the configuration, proposed according to the invention, of the low-pressure circuit 64 of the fuel injection system in accordance with Fig. 3, it is furthermore possible, when the fuel volume flowing out of the compensation container 51 is delivered to the second infeed point 62 immediately downstream of the fuel filter 17, to design the fuel filter 17, ~~58~~ for smaller volumetric flows of fuel, which has a very favorable effect on the structural size of pump components and filter components inside the low-pressure circuit 64 of the fuel injection system proposed according to the invention.

Please replace paragraph [0042] with the following amended paragraph:

[0042] A further reduction in the volumetric flow of fuel to be delivered to the high-pressure pumping unit 1 by the prefeed pump 55, the filter ~~element~~ 17 and the metering unit 59 can be implemented by depressurizing the leakage quantity, flowing as shown in Fig. 3 into the fuel tank 14 via the return line 13 assigned to the fuel injectors 10 and via a partial-quantity return 65, likewise only down to the prefeed pressure to be produced by the prefeed pump 55. This volumetric flow of fuel, flowing away from the fuel injector 10 or fuel injectors 10 via the return line 13, is preferably fed into the low-pressure circuit 64 downstream of the compression side 56 of the prefeed pump 55. As a result, even in fuel injection systems that are embodied without pressure boosters, the fuel quantity to be pumped by the prefeed pump 55 can be reduced. Depending on the design of the fuel injectors 10 and on the fuel pressure produced in the common rail 4 by the high-pressure pumping unit 1, the return quantity from the fuel injector or fuel injectors 10 may make up a considerable proportion of the total fuel quantity. The return quantity flowing away from the fuel injector 10 is composed essentially of the volumetric flow of fuel diverted into the nozzle spring chamber 39 upon the opening motion of the injection valve member and the control volume flowing out of the control

chamber 34 via the outlet throttle 36 upon actuation of the switching valve 32. In the fuel injection system shown in Fig. 3 for supplying a 6-cylinder self-igniting internal combustion engine, the returns 53 from further fuel injectors 10, which are not shown in detail here, are represented by arrows pointing to the return line 13.

Page 15, please add the following new paragraph after paragraph [0043]:

[0044] The foregoing relates to a preferred exemplary embodiments of the invention, it being understood that other variants and embodiments thereof are possible within the spirit and scope of the invention, the latter being defined by the appended claims.

Please delete pages 16, 17 and 18.